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(54) Secondary backing for tufted carpets

(57) A non-woven fabric comprising filaments of a polyester or copolyester, in which the filaments have been deposited individually or in groups such that there are parallel and intersecting filaments, and in which the coefficient of variation of the filament or filament group separation is at least 100%. This fabric can be used as a secondary backing for a tufted carpet.

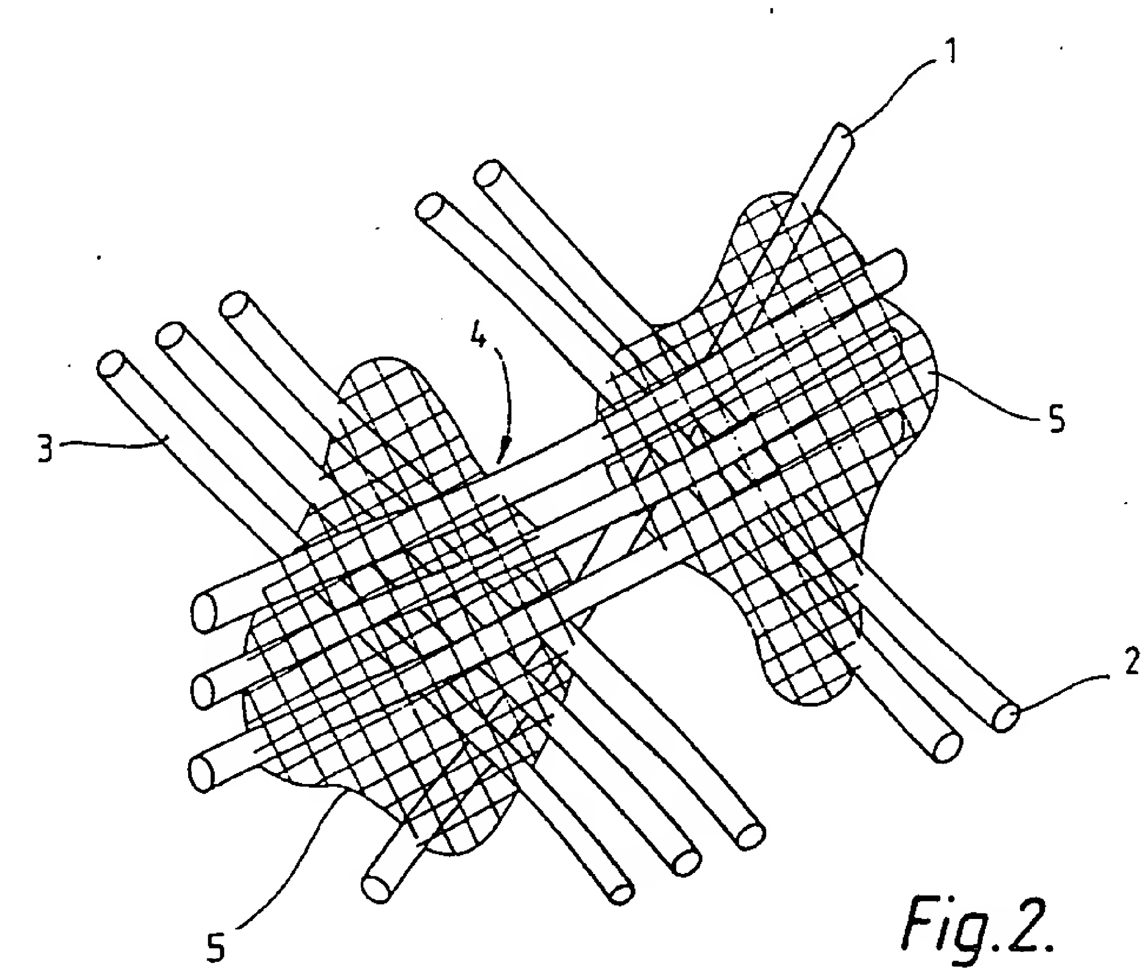

Fig.2.

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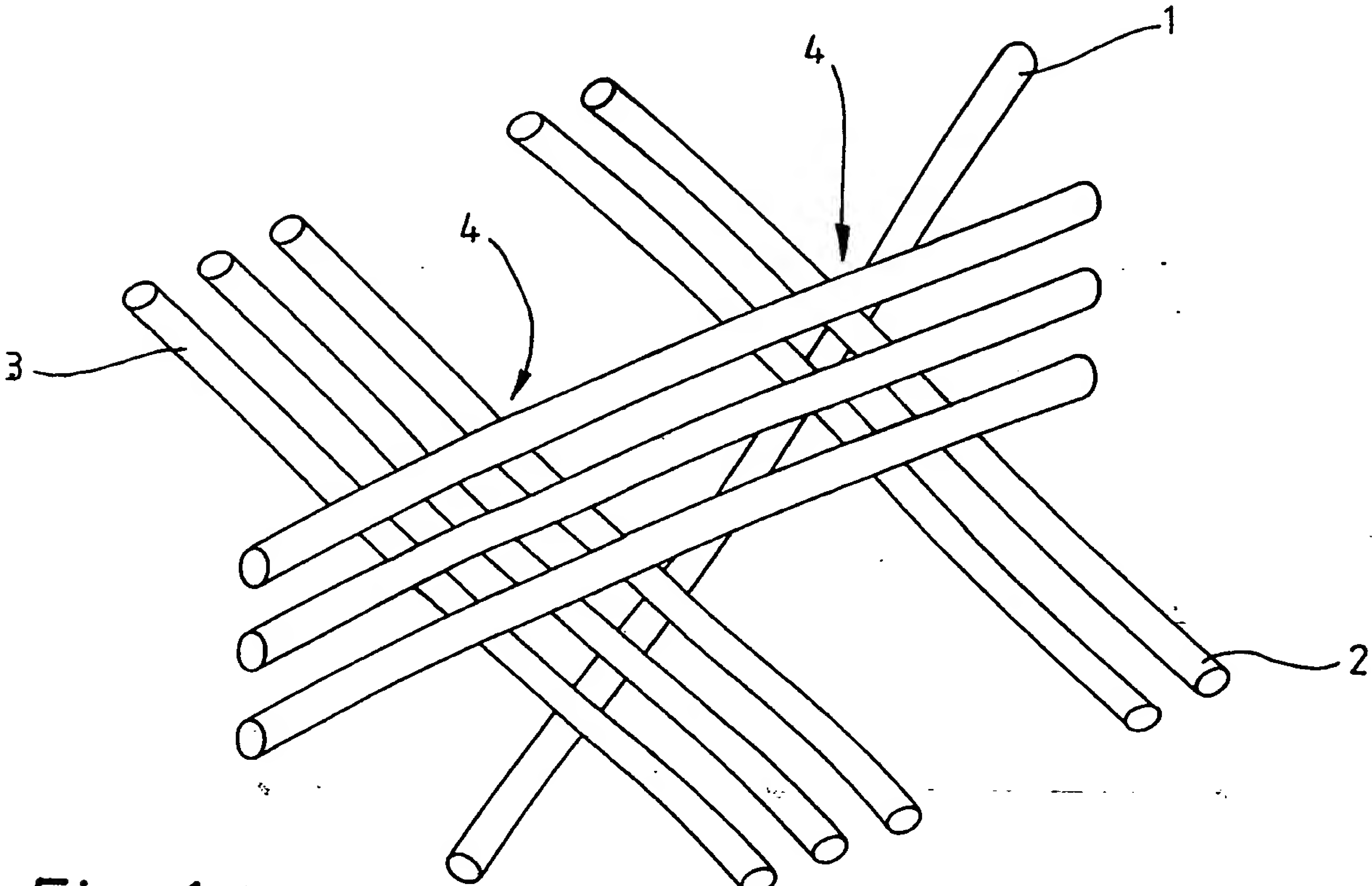

Fig.1.

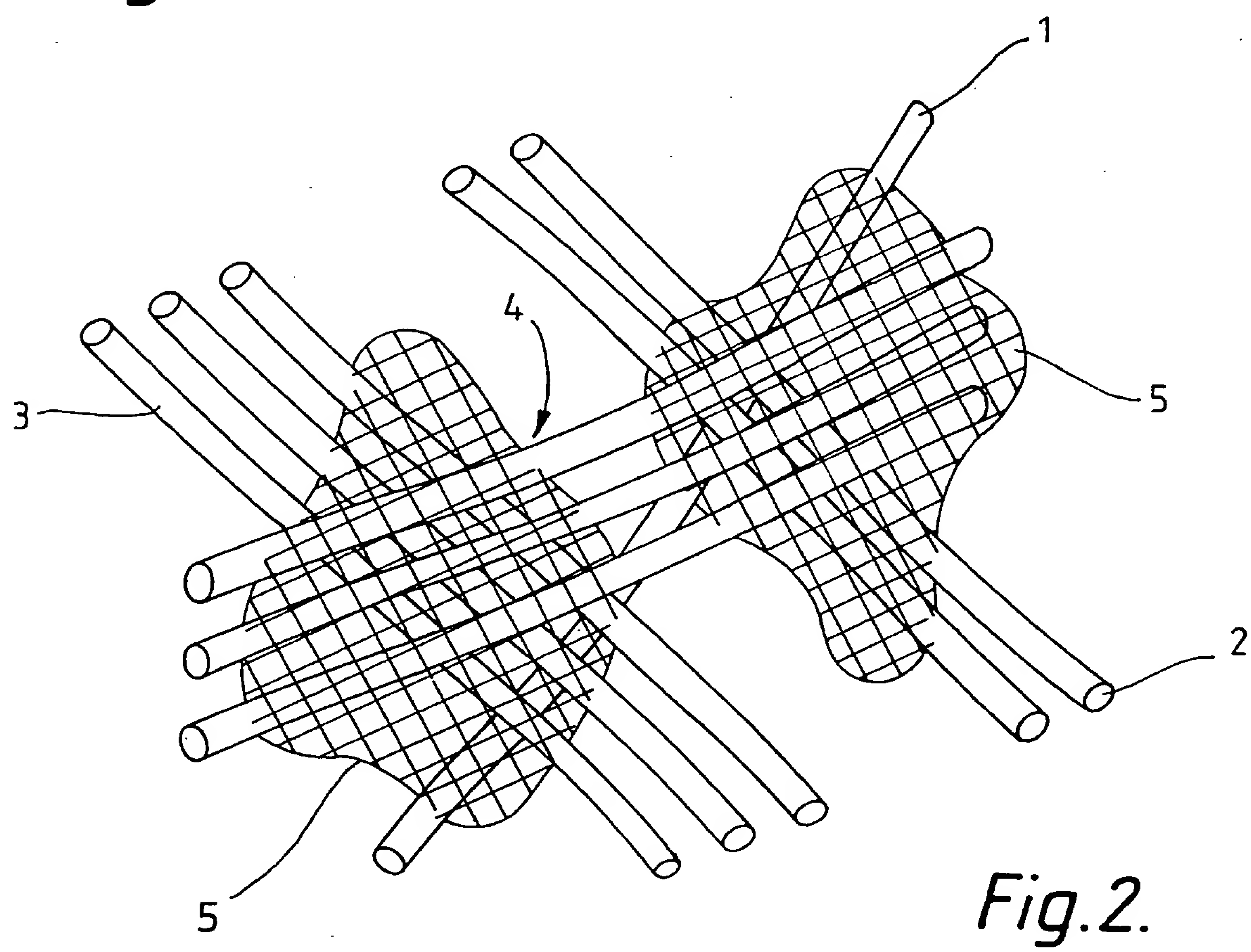

Fig.2.

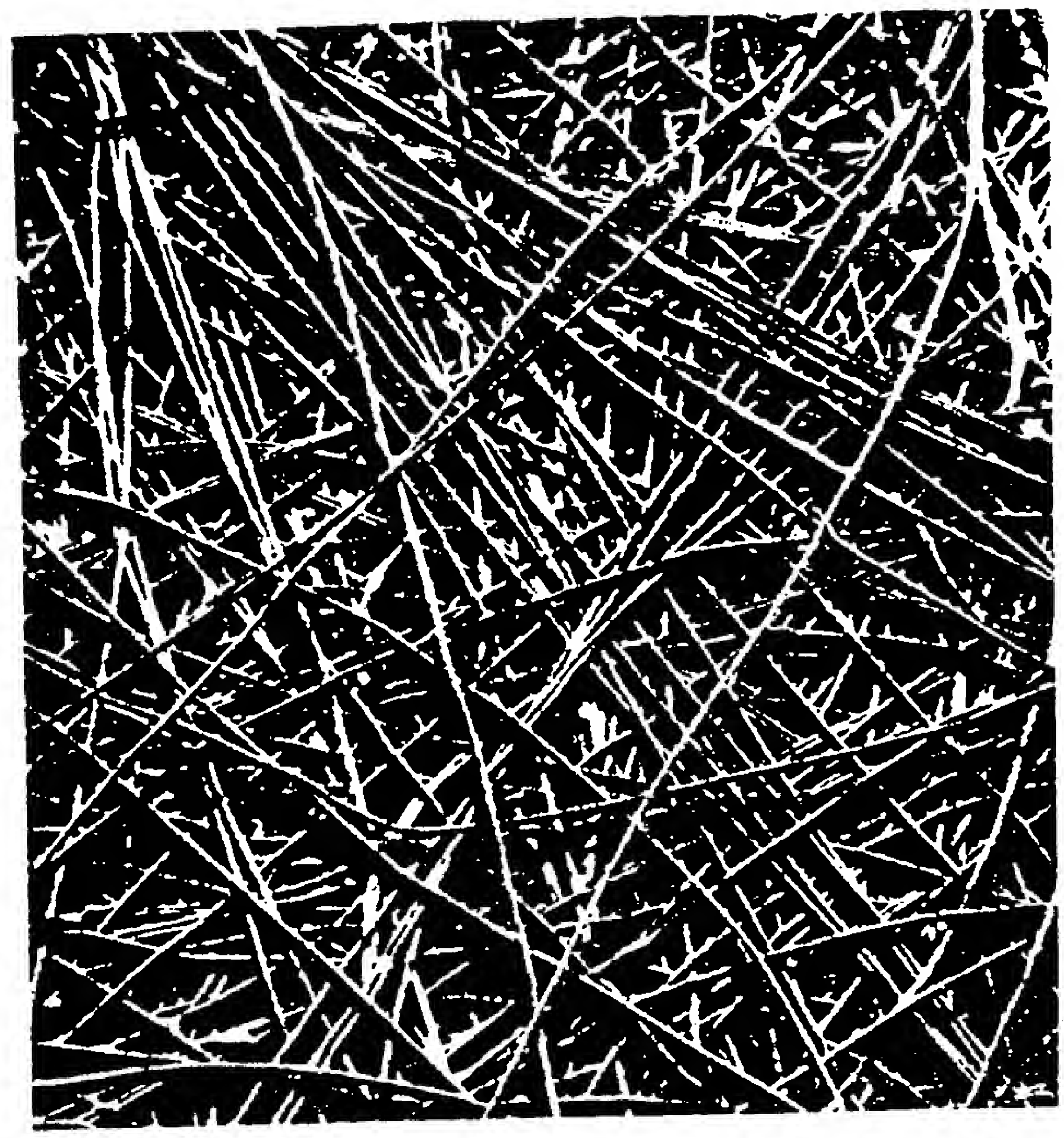

Fig. 3.

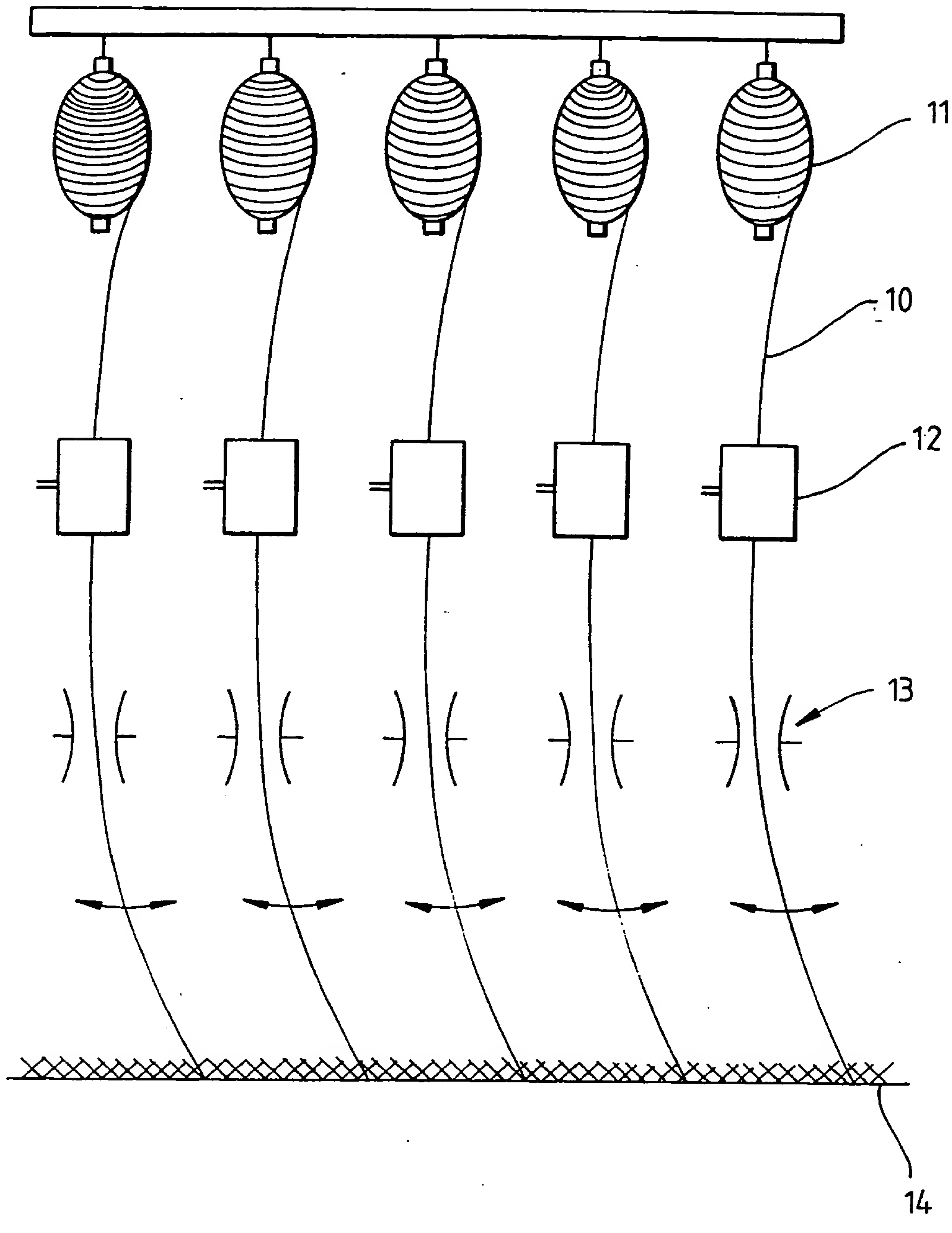

Fig .4.

SPECIFICATION
Secondary backing for tufted carpets

This invention relates to a secondary backing material for tufted carpets, comprising a non-woven fabric composed of polyester filaments and/or groups of polyester filaments.

As a rule, a backing for a tufted carpet comprises either an elastomer foam or a textile material. It is often called a secondary backing. The function of the secondary backing is, on the one hand, to give the tufted carpet good stability and, on the other hand, to create a satisfactory slipping or sliding combination of surfaces when the carpet furnished with the secondary backing is laid on top of a foam underlay which, in turn, must have a layer of a satisfactorily slipping textile material. Only in this way can it be ensured that, when the carpet is laid from wall to wall, deformations of the two layers occurring when the carpet is walked on or otherwise used do not form lasting waves which would spoil the appearance and, in certain circumstances, endanger users.

One well-known secondary backing material is a predominantly woven jute fabric which, in addition to the above-described functions, simulates the appearance of a conventional woven carpet. While it is true that a woven jute fabric satisfies the most important requirements, i.e. dimensional stability and the strength needed to compensate for the weakening of the primary tuft support on needling, and partly also the requirement of sliding ability on the underlay, it also has important disadvantages. A woven jute fabric is often the sole non-synthetic component of the entire carpet structure and, as such, is not rot-proof. Moreover, micro-organisms such as bacteria and fungi can multiply in this layer and can impair the hygienic properties of the product. Further, jute is a natural product of only limited availability. Finally, a jute secondary backing may weigh more than 200 g/m^2 in order to achieve the necessary properties.

Attempts have recently been made to develop a secondary backing comprising woven or non-woven polypropylene. However, polypropylene materials lack thermal stability. Their shrinkage on heating results in a bimetallic effect in the finished carpet, and waviness or buckling may occur. Further, when conventional synthetic latices are used to anchor the pile loops in the first tuft support, to stabilise it and to act as an adhesive for lamination to a secondary backing, too low a degree of adhesion is achieved if that backing is a woven polypropylene fabric. Although this problem can to some extent be overcome by using, for example, a perforated non-woven fabric or a woven polypropylene made from spun yarns, the bond with the unfinished carpet is still unsatisfactory.

According to the present invention, a secondary backing material for tufted carpets comprises a non-woven fabric comprising filaments and/or groups of filaments composed of polyesters and/or copolyesters known *per se*. The secondary backing material according to the invention is characterised in that the non-woven fabric contains the filaments and/or groups of filaments in an intersecting parallel texture with a coefficient of variation of the separation of the filaments of more than 100% and preferably at least 120%. The deposit of the filaments and/or groups of filaments in intersected parallel structure, i.e. with no preferred direction of deposit, gives both isotropic strength properties and a specific pore structure.

Spun non-wovens comprising filaments and/or groups of filaments with an intersecting parallel texture are described in U.S. Patent Specification No. 3,554,854. The filaments or filament strands are arranged substantially parallel to one another, a plurality of groups being provided which intersect and are bonded at the points of intersection.

The porosity and adhesion of the novel secondary backing may be adjusted by controlling the degree of separation of the filaments. A secondary backing consisting of polyester filaments in intersecting parallel structure can have high dimensional stability, strength, excellent adhesion to a tufted carpet and a first-rate appearance. This can be achieved by spinning the polyester filaments in group form, or drawing or winding them off together, and then depositing them together to form a non-woven of intersecting parallel texture. In the process, the porosity can be adjusted as described. A sheet structure with good adhesive properties can be obtained.

The porosity of the non-woven is determined firstly, at one pass, by the spinning of the polyester filaments in group form by the method disclosed in U.S. Patent Specification No. 3,554,854. According to the percentage and the degree of parallelisation of the filaments in any group, the porosity can be adjusted in a specific manner for a given weight per unit area. This avoids the need for subsequent, conventional, needling to obtain a surface structure suitable for adhesion. For a given weight per unit area, an increase in the bunching of the filaments to form groups of filaments means an increase in the porosity of the sheet structure.

By ensuring satisfactory porosity, good penetration of the adhesive employed in lamination is ensured. The desired adhesion can be promoted by producing the non-woven fabric, not solely from polyester filaments, e.g. of polyethylene terephthalate, but by using a mixed non-woven comprising spun-in or added copolyester filaments. It has been found that, in a carpet lamination process, copolyester filaments in a backing adhere substantially more readily than pure polyester filaments. Suitable fibres or filaments of copolyesters are of, for example, ethylene glycol, terephthalic acid and adipic acid, butylene glycol, terephthalic acid and adipic acid or butylene glycol, terephthalic acid and isophthalic acid.

It is often preferred that the spun non-woven secondary backing has colouring materials and/or

bonding agents printed on in dot or screen form. A geometrical, woven fabric-like structure can be achieved in this way, as well as local compression to ensure a given pore structure. The adhesive employed in the lamination of the finished carpet penetrates into the areas of compression to a lesser degree than into the adjacent areas, so that a certain suction cup effect and high adhesion values are achieved. The degree of surface coverage is determined, on the one hand, by the degree of separation of the filaments and, on the other hand, by local overprinting in consideration of the desired air permeability.

It is preferred to prepare a secondary backing material according to the invention as a spun non-woven by deposition from spinnerets. Alternatively, the intersecting parallel texture may be produced by drawing the filaments and/or bundles of filaments off bobbins or cops and depositing them in an intersecting arrangement.

In the preparation of a product of the invention, conventional spinning methods may be used. The apparatus described, for example, in U.S. Patent Specification No. 3,554,854 (Figure 2) has proved particularly satisfactory. In this apparatus, sheets of filaments are spun in the form of groups from a series of adjacent spinnerets and are delivered to a collecting belt with the aid of guide ducts. The sheets of filaments are both stretched and guided by means of air by the stretch-spinning process. A series of spinnerets, disposed side-by-side, is arranged in spinning beams. Figure 3 of U.S. Patent Specification No. 3,554,854 shows such a spinning beam, with a group of three spinning holes (106) in each case in the series, as a result of which three filaments are spun per group. One of the spinning holes has a distinct diameter, so that parallelised groups of filaments of different diameters are built up. If desired, a copolyester can be spun from the larger holes and a polyester from the smaller holes, while the groups of filaments may also differ, chemically. The filaments making up a mixed non-woven may consequently differ both physically and chemically.

When the filaments are deposited on a collecting belt, a spun non-woven of intersecting parallel texture is obtained. Parallel extending filaments are built up to form the non-woven, without any preferred orientation, by being intersected or crossed.

In the formation of the non-woven on a collecting belt having subjacent suction means, the filaments are delivered to the collecting belt by means of drawing and guiding air streams, whether in spinning or in drawing-off from bobbin creels. The resultant irregular non-woven of intersecting parallel texture has an isotropic disposition of the filaments and/or groups of filaments with partly parallel extending filaments deposited in intersecting arrangement without any preferred direction of deposit. Depending on the turbulence in the zone of formation of the non-woven, a more or less intense mixing together of the filaments and/or groups of filaments takes place and also, to some extent, a partial dissociation of filaments from the group formation, so that in general the finished spun non-woven consists of a mixture of separate filaments and groups, e.g. of two or three, or multi-filament groups which are deposited in intersecting arrangement.

The more the vacuum below the collecting belt is increased during the formation of the non-woven, the more strongly the filaments and/or groups of filaments are fixed in position directly on encountering the collecting belt and the more strongly their position, prescribed by the configuration of the spinning holes, is maintained; accordingly, the more specifically the mixture of certain proportions by weight of separate filaments and groups of one and two or three can be prescribed. In the event of removal of the air streams, or by using a lower degree of suction, greater turbulence is produced in the region of the collecting zone and there is more pronounced mixing together and also more pronounced splitting up of the groups into separate filaments.

For many purposes, it has proved useful to produce the spun non-woven according to the invention in accordance with German Patent Specification No. 2,240,437 (U.S. Patent Specification No. 3,975,224). This is advantageous when, for example, higher loading of the aerodynamic draw-off duct with filaments is desirable, so that a controlled bunching or bundling of the matrix and bonding filaments is produced. the number of filaments per cm^2 of the free area of the cross-section of the draw-off duct is suitably a little more than 10. After leaving the draw-off ducts, the groups or bundles of filaments are deposited in an intersecting parallel texture or structure, that is layer upon layer of the filaments and/or groups of filaments are arranged one on top of the other while being intersected or crossed.

A non-woven of the type described may be consolidated using bonding fibres. In this case, after collection, the non-woven is consolidated by applying pressure and heat, for example by means of a heated calendar. Preferably, following consolidation by using a calendar, the non-woven is printed on, e.g. by means of a screen of dot or woven fabric type, in a manner such that it is not wholly covered with printing ink and/or bonding agents, but that a certain porosity is achieved. The result is that unprinted areas of higher porosity and higher bonding agent absorption are obtained in the subsequent lamination with a tufted carpet. To this end, a permeability to air of more than 300, and preferably more than 500, dm^3/m^2/sec, measured at 0.5 mbar gauge pressure, according to DIN 53887, is achieved both by specific bunching and/or by printing bonding agents on in dot form in the finished secondary backing of non-woven fabric. Such permeability values allow good adhesion of the backing to a carpet.

Following the printing operation, the non-woven may be carried over a perforated drum, hot air being blown from the interior of the drum. The

air passes through the non-woven which is stretched around the drum.

The non-woven may comprise only one kind of filament, e.g. polyethylene terephthalate. The filaments and/or groups of filaments are arranged, one on top of the other, in layers, while intersecting or crossing. In this case, intersection of the filaments and/or groups of filaments is produced on the collecting belt by arranging, one on top of the other in layers, groups of two or three parallelised filaments or multiple groups thereof. The non-woven may then be consolidated by screen-type printing on of bonding agent dispersions which optionally contain colouring pigments. the filaments are thus bonded locally.

The non-woven is more porous and absorbent between the printed-on bonding areas than in these printed areas. Accordingly, good strength of adhesion can be achieved on lamination to form a finished carpet.

the intersecting parallel texture of a non-woven of the type described is characterised by a high coefficient of variation of the separation of the filaments, which points to a marked bunching or bundling. On the one hand, the high number of filaments per unit area gives the strength values and mechanical properties necessary for the material; on the other hand, the porosity which is desirable for sticking the secondary backing to a tufted carpet can be determined by the degree of parallelisation of the filaments. The degree of parallelisation varies according to the coefficient of variation of the separation of the filaments.

The coefficient of variation of the separation of the filaments (V_{fs}) depends on the distance between individual filaments of the non-woven fabric and calculation of its coefficient of variation. Thin non-woven fabrics, up to about 0.15 mm thick, can be measured directly. Thicker materials must be split without changing the position of the fibres. With unbonded or non-bonded materials, this can be effected by direct delamination. With more strongly bonded materials, it is advisable first to embed them in a suitable material, then to split them into layers about 100 μ thick using a microtome.

The measurement itself can best be carried out directly at 50 × magnification with a microscope which is equipped with a micrometer eyepiece. The distance between the parallel filaments is measured in both longitudinal and transverse directions and in both direction at an angle of $\pm 2°$ with respect to the reference lines of direction defined as parallel. The distance between the edges defining the filament image in the same sense is designated as the distance between two filaments. In each test, the number of measured distances between filaments should be at least 200 and is desirably about 400. In the measurement process, the image is divided by a straight line which follows the direction to be measured and the distances between those filaments which make an angle of $90 \pm 2°$ with this straight line are taken into consideration.

V_{fs} is determined from the formula

$$V_{fs}(\%) = 100S/\bar{x}$$

in which S is the standard deviation of the collection or group of measurement and $\bar{x}$ is the average distance between filaments.

$$S = [(x_1 - \bar{x})^2/(n-1)]^{1/2}$$

in which x_1 is the particular individual value of the distance between filaments and n is the number of measurements.

$$\bar{x} = (\Sigma x_1)/n$$

In addition to the parameters of air permeability and filament separation of the filaments, the weight per unit area can also be an important feature. At less than 40 g/m², the desired air permeability can be achieved by a suitably high degree of overprinting, but there is then insufficient reinforcement of the finished carpet. Above 150 g/m², it is possible to achieve both high mechanical strength values, by suitable adjustment of the separation of the filaments or group formation, and good adhesion, by choosing a suitable porosity value, measured by the air permeability; however, such secondary backings tend to delaminate, and this is a critical disadvantage. The preferred weight per unit area is therefore from 40 to 150 g/m².

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figures 1 and 2 are diagrammatic representations of a secondary backing material of the invention, showing the necessary intersecting parallel texture or structure of individual filaments 1 and/or groups of filaments 2 and 3 which intersect at the points 4. Figure 2 additionally shows overprinted areas 5 containing a supplementary bonding agent. For the same weight per unit area, larger pores, or spaces between the points of intersection, are obtained as a result of more bunching and parallelisation of filaments and/or groups of filament. The pores or interspaces affect the adhesion properties of the secondary backing material.

Figure 3 is a stereophotograph of a random non-woven of the invention with an intersecting parallel texture. An isotropic disposition of the filaments and/or groups of filaments, with partially parallel extending filaments deposited in intersecting arrangement without any preferred direction of deposit, can be seen.

Figure 4 is a diagrammatic representation of apparatus suitable for the production of a secondary backing material according to the invention, as an alternative to the spinning method disclosed in U.S. Patent Specification No. 3,554,854. Filaments and/or bundles of filaments 10 are unwound from bobbin creels or cops 11 using aerodynamic draw-off devices 12. Then, by means of an oscillating device 13 they are oscillated as shown by the double-ended arrows and collected on a belt 14 in the form of a matting

composed of bundles of continuous filaments, of the type shown in the other drawings. Consolidation may then be effected by mixing in and heating bonding filaments or by the application of bonding agent, for example by impregnation or printing on. The pore structure of the product may be controlled by the nature of the filaments and the number of filaments in any group.

The following examples illustrate the invention.

EXAMPLE 1

Apparatus as shown in Figure 2 of U.S. Patent Specification No. 3,554,854 was used. Each spinneret had two different kinds of holes which were respectively in communication with one of the two distribution systems for polymer melt. The holes were arranged in the form of groups as shown in Figure 3 of the same Patent Specification, so that one arrangement always comprised two holes A and one hole B. Holes A had a diameter of 0.3 mm, and were supplied with a polyethylene terephthalate melt. Holes B had a diameter of 0.5 mm and were supplied with a melt of a copolyester derived from terephthalic acid and butylene glycol.

The filaments produced were then conducted through an air duct (39) which was provided on its longitudinal sides with air slots through which the draw-off air flowed. The ambient air flowed in freely between the spinneret and the air duct. The filaments drawn down by the air streams were stretched and cooled and a non-woven was deposited on a screen belt running below the air ducts. In the process a structure as appearing in Figure 1 of the accompanying drawings was produced wherein the groups of filaments intersected and extended irregularly with respect to the direction of movement of the screen belt and of the fabric formed.

The non-woven formed was passed through a calendar heated to 145°C and then fixed or set at 195°C in a continuous flow drier.

The consolidated spun non-woven weighed 50 g/m², was 0.24 mm thick, and had a maximum elongation in tension of 30%. both lengthwise and transversely, a permeability to air of 1950 dm³/m²/s at 0.5 mbar, and a coefficient of filament separation variation of 138%.

From microscopic examination, the material had an intersecting parallel texture.

The spun non-woven fabric was employed as a secondary backing by being applied to the back of a printed-on uncut-pile carpet with a machine gauge of 5/64" and 54 E/10 cm which had been coated on the back with about 700 g/m² of a latex dispersion which had been pregelled. Good wetting and also very good adhesion of the secondary backing was obtained.

EXAMPLE 2

Apparatus according to German Patent Specification No. 2,240,437 was used. A spinning unit consisting of two spinnerets disposed side by side and of elongated shape was employed. Each spinneret was supplied with polymer melt from an extruder by means of a geared pump used as a metering pump.

Spinneret A served to produce matrix filaments of polyethylene terephthalate and had 64 holes with a capillary diameter of 0.3 mm, while the capillary length was 0.75 mm. The holes were arranged in two rows over a length of 280 mm.

Spinneret B served to produce bonding filaments and had 32 holes, likewise with a capillary diameter of 0.3 mm and a capillary length of 0.75 mm. The holes were arranged in one row over a length of 280 mm. A copolyester of 77 mole % terephthalic acid, 23 mole % adipic acid and ethylene glycol was used as raw material for the bonding fibres. The mass ratio of the matrix and bonding fibres was 80:20. Below the spinneret, air was blown onto the filaments formed transversely of the direction of movement over a length of 150 mm and they were then passed through a protective shaft to an aerodynamic draw-off device. A flat injector with a width of 300 mm and an inlet slot depth of 4 mm was employed as the draw-off device. Below the draw-off injector an endless wire gauze was arranged. The matrix and bonding filaments, mixed in a draw-off injector at a flow velocity adjusted to 16,000 m/min, were laid on the belt to form a random filament non-woven, the air being drawn off by suction. The running speed of the endless depositing belt determined the weight per unit area of the non-woven.

Partial bunching or bundling was caused by contact between the two sheets of filaments, so that the filaments were drawn off in frequently changing groups and deposited in intersecting parallel structures.

The random filament non-woven was removed from the endless belt and passed through the nip of two metal rolls heated to 120°C. The roll nip was set at 0.4 mm. The non-woven was thereby compressed and consolidated. The compressed random filament non-woven was then passed to a second consolidating apparatus.

This second apparatus consisted of a revolving endless screen belt which was tensioned below a perforated roll. Between the perforated roll surface and the revolving screen belt, air at 225°C was blown through the random filament non-woven in a fixed-area state. The sheet structure, now twice consolidated, was removed continuously from the apparatus and wound into rolls.

The spun non-woven fabric had an intersecting parallel texture such as can be seen in Figure 2. The coefficient of variation of the separation of the filaments was 134%. The non-woven weighed 70 g/m², was 0.32 mm thick, and had a maximum tensile strength of 156 N/5 cm, lengthwise, and 142 N/5 cm, transversely, a maximum elongation in tension of 42%, both lengthwise and transversely, and a permeability to air of 1500 dm³/m²/s at 0.5 mbar.

The spun non-woven fabric was printed with a pigment-containing dispersion paste and employed as secondary backing. In this process, it

was laminated with a cut-pile carpet having a machine gauge of 1/16 inch by means of a latex dispersion which was applied to the back of the carpet in an amount of 900 g/m^2. The adhesion of the secondary backing was good.

The permeability to air in the printed state was 830 dm^3/m^2.

EXAMPLE 3

A polyester filament yarn with a total denier of 167 dtex for 68 filaments (filament denier 2.5 dtex) was drawn off a creel by a two-roll delivery apparatus and fed to round air injectors whose outlet opening was equipped with a butterfly or wing diffuser which produced a fanning-out of the filaments.

Ten such stations were arranged per 1 m of width. The fanned-out filaments, which also formed bundles containing a carying number of filaments, were laid on a screen belt to form a non-woven, suction being applied to the laying zone from below. The non-woven was compressed by means of a calendar at 180°C and then printed with a rodlet-type structure with a dispersion consisting of an acrylate bonding agent. The weight of fibre was 80 g/m^2 and the amount of bonding agent applied was 10 g/m^2, so that the finished non-woven weighed 90 g/m^2. It was 0.03 mm thick and had a maximum tensile strength of 190 N/5 cm, lengthwise and 183 N/5 cm, transversely, an elongation in tension of 63%, both lengthwise and transversely, a permeability to air at 0.5 mbar of 650 $dm^3/m^2/s$ and a coefficient of variation of filament separation of 162%.

The non-woven fabric exhibited good adhesion to a carpet after being applied to its back and bonded with a latex dispersion.

CLAIMS

1. A non-woven fabric comprising filaments of a polyester or copolyester, in which the filaments have been deposited individually or in groups such that there are parallel and intersecting filaments, and in which the coefficient of variation of the filament or filament group separation is at least 100%.

2. A fabric according to claim 1 in which the coefficient of variation of separation is at least 120%.

3. A fabric according to claim 1 or claim 2, which has an air permeability of at least 300 $dm^3/m^2/s$ at a gauge pressure of 0.5 mbar.

4. A fabric according to claim 3, which has an air permeability of at least 500 $dm^3/m^2/s$ at a gauge pressure of 0.5 mbar.

5. A fabric according to any preceding claim in which the filaments are of a copolyester modified by the addition of adipic acid.

6. A fabric according to any of claims 1 to 4 in which the filaments are of a copolyester modified by the addition of isophthalic acid.

7. A fabric according to any of claims 1 to 4 in which the filaments are of a copolyester modified by the addition of butylene glycol.

8. A fabric according to any preceding claim in which some at least of the filaments are pigmented.

9. A fabric according to any preceding claim on to which zones of bonding agents have been printed, the fabric thus having a non-uniform density.

10. A fabric according to any preceding claim, which weighs from 40 to 150 g/m^2.

11. A fabric according to claim 1 substantially as described in any of the Examples.

12. A fabric according to claim 1 substantially as illustrated in any of the accompanying drawings.

13. A fabric according to any preceding claim for use as a secondary backing for a carpet.

14. A tufted carpet including, as a secondary backing, a fabric according to any preceding claim.

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